Neurobiological Bases of Suicidality in Major Depression

Martin Desseilles, MD 1,2,4,5; Sophie Schwartz, PhD 4,5 ; Thien Thanh Dang-Vu, MD, PhD 1,3; Virginie Sterpenich, PhD 1; Geneviève Albouy, PhD 1; Christina Schmidt, MPsych 1; Eric Salmon, MD, PhD 1,3; Annabelle Darsaud, PhD 1; Gilles Vandewalle, PhD 1; Evelyne Balteau, PhD 3; Christian Degueldre, MSc 1; Christophe Phillips, PhD 1; Andre Luxen, PhD 1; Marc Ansseau, MD, PhD 1; Pierre Maquet, MD, PhD 1,3

Author Affiliations:
1 Cyclotron Research Centre, University of Liège, Belgium
2 Department of Psychiatry, University of Liège, Belgium
3 Department of Neurology, University of Liège, Belgium
4 Department of Neurosciences, University of Geneva, Switzerland
5 Geneva Neuroscience Center, University of Geneva, Switzerland

Topic

Neuroimaging: Functional

Objectives

Suicide is a major public health problem that typically occurs in the context of a depression. We used functional magnetic resonance imaging to reveal the neurobiological correlates of suicidality in depressed patients.

Methods

The present 3 Tesla fMRI study was conducted in 14 non-medicated patients with a first episode of unipolar MDD and 14 matched controls. During scanning, subjects performed two tasks imposing two different levels of attentional load at fixation (easy or difficult, i.e. low or high attentional load), while irrelevant stimuli (i.e. faces) were presented in the periphery. To obtain an unbiased measure of suicidality from the Hamilton Rating Scale for Depression (HRSD) scores, we computed their singular value decomposition, a mathematical procedure related to principal component analysis.

Functional MRI data were analyzed using a two-step procedure taking into account the intra-individual and inter-individual variance. The summary statistics images of the individual level were entered into a second-level one-way ANOVA implemented in SPM2 (http://www.fil.ion.ucl.ac.uk) to assess random-effects group comparisons.

We performed additional whole-brain second-level correlation analyses for the main contrasts of interest using a component of the HDRS as covariates avec singular value decomposition of the scale.

Results

When asked to engage attention in a cognitive task (high > low attentional load) depressed patients activated noradrenergic locus coeruleus, serotonergic raphé nuclei and amygdala in proportion of their suicidality.

Conclusions

In animals, activity in the mesopontine reticular formation and amygdala can promote rapid behavioral shifts in response to cognitive challenges by facilitating the functional reorganization of cortical networks. Our results suggest that, in the context of high attentional demands, depressed patients may be prone to impulsive shifts in behavioral states. These findings suggest that suicide prevention could be achieved by a better control over amygdalar activity and its modulation by aminergic neuromodulators.

Financial Support
Research supported by the Fonds National de la Recherche Scientifique (FNRS, Belgium; grant number 3.4516.05), the University of Liege and the Queen Elisabeth Medical Foundation (Belgium). This research was also funded by the Swiss National Science Foundation (grants #310000-114008, #3200B0-104100 to S.S.) and by the National Centre of Competence in Research (NCCR) in Affective Sciences financed by the Swiss National Science Foundation and hosted by the University of Geneva.